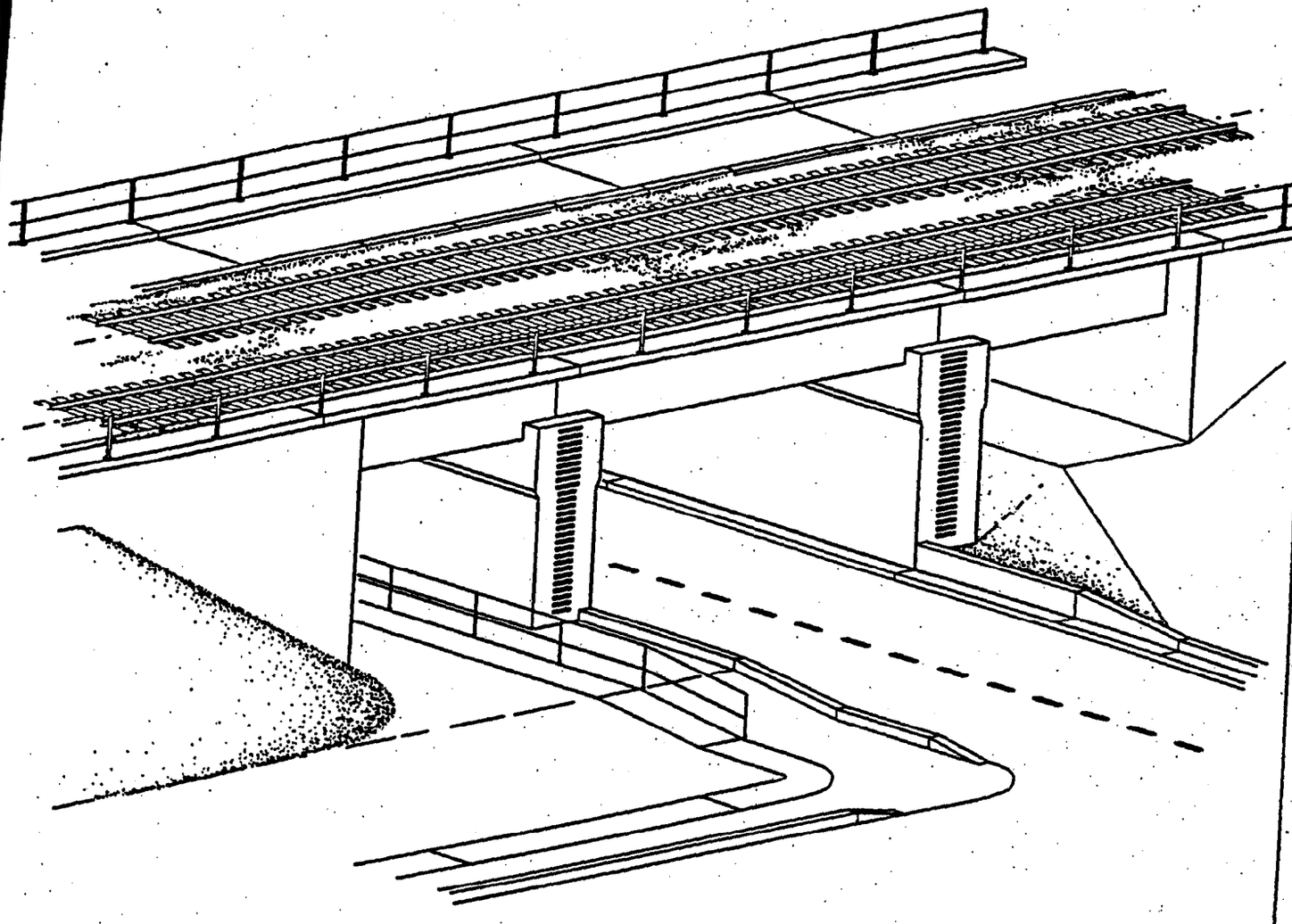
EXHIBIT E

GUIDELINES FOR DESIGN AND CONSTRUCTION OF GRADE SEPARATION UNDERPASS STRUCTURES



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UNION PACIFIC RAILROAD COMPANY

UNDERPASS GRADE SEPARATION STRUCTURES

I PURPOSE AND SCOPE

The intent of this guideline is to inform public agencies, design engineers and contractors of Union Pacific Railroad Company's current standards and requirements concerning design and construction of grade separation underpass structures.

Continuity of safe rail operations shall be required for the duration of the project and construction work shall in no way impede the train operations of the Union Pacific Railroad.

The specific requirements adressed in this document should be followed for structures on which the Union Pacific Railroad operates regardless of whether it is maintained by Union Pacific Railroad. Compliance with these requirements will help to expedite the completion of design and construction reviews.

Designs of all public works projects shall be prepared either by the engineering staff of that agency or a consulting engineer who has been approved by both Union Pacific Railroad Company and that public agency.

Selection of consultants shall be limited to those who are familiar with the design of railroad bridges, and particularly with the special requirements and operating conditions of the Union Pacific Railroad Company.

Public Agency or their representative shall provide information requested on attached data sheet to the Manager of Industry and Public Projects of the district that project is located in the preliminary stages of the project. See Data Sheet, Appendix A.

This guideline supplements the applicable sections of the American Railway Engineering Association (AREA) Manual of Recommended Practice in connection with the design of ballast deck railway bridges.

II STRUCTURE SELECTION CRITERIA

1. Grade separation underpass structures shall be ballast deck type structures. Open deck type structures shall not be used as permanent structures. Open deck type structures can be used only for temporary structures built in

conjunction with shoofly construction.

2. When possible, simple span structures should be used.

3. Continuous span, deck or through truss type structures are to be avoided.

4. Trough type post-tensioned simple or continuous structures are not acceptable.

5. Grade separation structures may require inside guard rail. Refer to Union Pacific Railroad Company standard drawing **4005** (Double Inside Guard Rail for Timber Ties) or **4015** (Double Inside Guard Rail for Concrete Ties) for details and requirements. See Appendix A.

III LIST OF PREFERABLE UNDERPASS STRUCTURES

Following is a list of underpass structures preferable to Union Pacific Railroad Company in priority order. The Union Pacific Railroad Company will require the most preferred alternative in all cases, unless the agency can provide sufficient reasons for proposing a less preferred alternative.

1. Steel plate girders with cast-in-place concrete deck. See drawing **UP1**, Appendix A.

2. Rolled beams with cast-in-place concrete deck. See drawing **UP2**, Appendix A.

3. Prestressed concrete box girders single or double cell. See drawing **UP3**, Appendix A.

4. Prestressed concrete "AASHTO" type girders with cast-in-place concrete deck. See drawing **UP4**, Appendix A.

5. Cast-in-place concrete box girders conventional reinforced. See drawing **UP5**, Appendix A.

6. Post-tensioned concrete box girders. See drawing **UP6**, Appendix A.

7. Through type simple supported steel girder spans with concrete or steel deck will be considered by the office of the Chief Engineer when conditions preclude any other solution. See drawing **UP7**, or **UP8**, Appendix A.

8. Grade separation underpass structures of deck or through truss design are not preferable. However, in unusual circumstances, they will be considered by the office of the Chief Engineer Design if conditions preclude the use of any other type of structure.

IV ACCESS TO UNDERPASS STRUCTURE

For all grade separation underpass structures, an access roadway or bridge maintenance structure shall be provided for Union Pacific Railroad Company off-track maintenance equipment.

Access roadway with a turnaround shall be designed and constructed in conjunction with the grade separation bridge structure. Turnaround pad shall start no further than 30 ft. from the end of bridge structure and with embankment shoulder 60 ft. minimum from centerline of track. Roadway grade should not exceed 10% and shall terminate at the sub ballast elevation. Roadway shall have sufficient width to provide for one 12 ft. wide road, drain ditch and shoulder. Roadway and turnaround shall be constructed on compacted material and have a 12 inch thick minimum base and 6 inch thick A.C. pavement. Turnaround pad and roadway shall be sloped to drain away from track subgrade and dispose water to drainage system or existing right-of-way ditches. All down slopes of turnaround pad and roadway shall be protected with A.C. curbs to prevent embankment erosion.

Bridge maintenance structure may be part of the railway supporting structure or a completely separate structure. If bridge maintenance structure is part of the main railway structure, the structure shall be designed for E-80 load to accommodate any future track needs or modifications. If bridge maintenance structure is a totally separate structure it shall be designed for HS20-44 live load. The bridge maintenance width shall accommodate one 12 ft. paved lane with curbs and railing. Deck of bridge structure shall be concrete with 6 inches thick A.C. pavement. Bridge deck shall provide curbs, railing, drainage, and joint seals as required. Pavement of deck shall extend 20 ft. past the end of the structure and be placed over a 12 inch thick minimum base.

Access roadway with turnaround or bridge maintenance structure shall be shown in the preliminary plans and complete design shall be included in all subsequent submittals.

V SPECIFICATIONS

A. Design Specifications:

Underpass grade separation structures shall be designed and constructed in accordance with the most current edition of the American Railway Engineering Association (AREA) Manual of Recommended Practice.

Separate bridge maintenance structure shall be designed and constructed in accordance with the current edition of the American Association of State Highway and Transportation Officials (AASHTO) standard specifications for highway bridges.

B. Construction Specifications:

Technical specifications for bridge construction shall comply with following:

1. AREA Specifications for Fabrication and Erection of Structural Steel (Chapter 15).

2. AREA Specifications for Concrete Structures and Foundations (Chapter 8)

3. AREA Specifications for Waterproofing (Chapter 29).

4. The Standard Specifications of the State's Highway Department or local agency responsible for the design and construction of highway bridges.

5. Standard Specifications of Public Works Department.

6. American Association of State Transportation and Highway Officials (AASHTO).

VI UNITS

Grade separation underpass projects that require the use of metric units shall indicate all controlling dimensions, elevations, design criteria assumptions, and material stresses in dual units. English units to be in parenthesis. Controlling dimensions refer to length of structure, span length, thickness of all deck elements. Controlling elevations refer to top of rail, rail profile, bridge seats, and footings. Design criteria or assumptions refer to live load, design speed etc.